Instructions: Ten points total. Show all work for credit.

1. (4 pts.)

   (a) (2 pts.) Prove that the following limit does not exist:

   $$\lim_{(x,y)\to(0,0)} \frac{x^3 y}{x^6 + 3y^2}$$

   (b) (2 pts.) Find the value of the limit below and give a brief mathematical justification that this limit exists.

   $$\lim_{(x,y)\to(3,2)} \frac{xy}{\sin\left(\frac{\pi}{y}\right) + e^{3y-2x}}$$

2. (6 pts.) Consider the function $g(x, y) = \sin\left(\dfrac{y}{1+x}\right)$.

(a) (2 pt.) Is the function $g(x, y)$ increasing, decreasing, or stable in the x-direction at the point in its domain $P(2, \pi,)$? Briefly justify your answer.

(b) (4 pts.) Find the equation of the tangent plane to $g(x, y)$ at the point $\left(2, \pi, g(2, \pi)\right)$.